# Designing Cyber Exercises

(ISC)$^2$ Pittsburgh Chapter

**CERT | Cyber Workforce Development**

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# CWD Mission

Provide force-multiplying solutions…

To rapidly grow the nation's cyber workforce…

Addressing the problems of time, scale, and cost

# CWD Perspective

## CWD Challenges

- Vulnerabilities, threats, and technologies change so rapidly
- Unlike adversaries, rule of law limits full freedom of maneuver
- Traditional “Brick and Mortar” training models
  - Difficult to train regularly due to logistics/budget restrictions
  - Doesn’t scale across a globally distributed workforce
  - Difficult to “train as you work” routinely
  - Difficult to assess individual/ team readiness routinely

## CWD Research/Solutions Focus

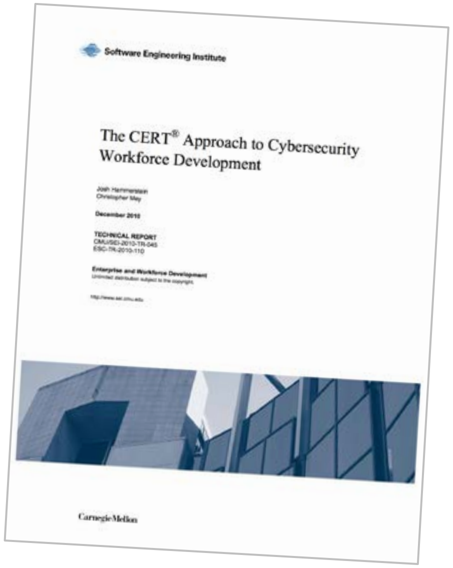
- Focuses on the problems of time, scale, and cost.
- Develop innovative methods to compress the time it takes to build cyber expertise and to amplify that expertise across a globally distributed workforce
- Emphasize individual/team readiness and effectiveness

# Overview

- Background
- Why develop an exercise
- Types of exercises
- Planning
- Design
- Development
- Execution
- Supporting documentation
- Lessons Learned

# Background

- Knowledge, skills, and experience
  - **Knowledge** building provides a solid foundation of knowledge; fundamentals and concepts
  - **Skill** building focuses on learning how to apply hands-on, technical skills
  - **Experience** building develops the ability to adapt and successfully apply skills in changing and unfamiliar environments; apply knowledge and skills in real world scenarios
- Skill proficiency
- Training scalability
  - Audience
  - Budget



Software Engineering Institute

The CERT® Approach to Cybersecurity Workforce Development

Josh Hammerstein
Christopher May

December 2010

TECHNICAL REPORT
CMU/SEI-2010-TR-045
ESC-TR-2010-110

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Source: The CERT® Approach to Cybersecurity Workforce Development

# Workforce Development Cycle

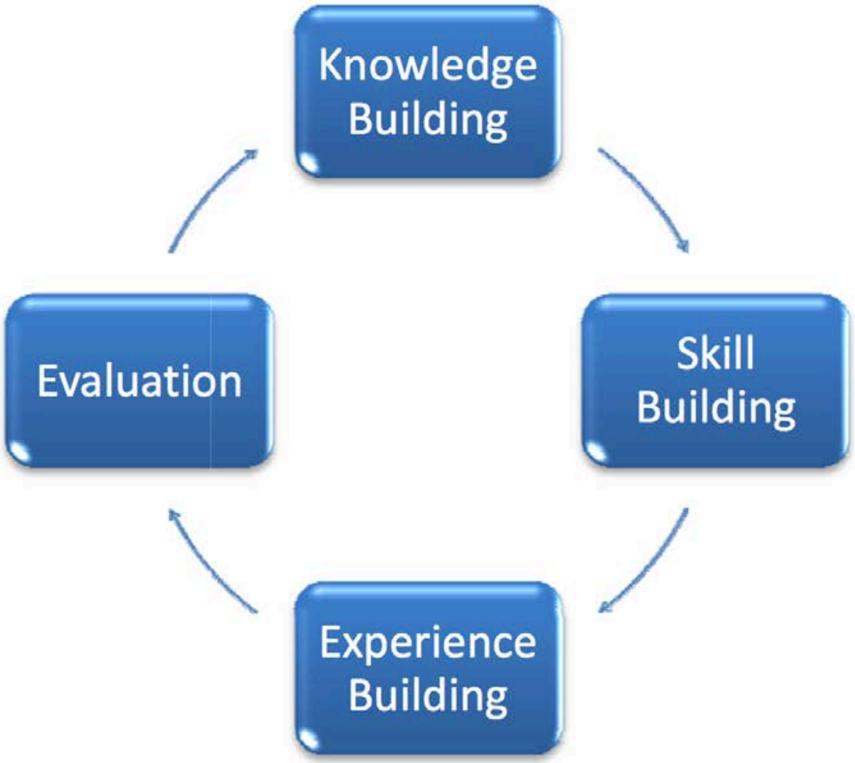


*Figure 1: The CERT Approach to Cybersecurity Workforce Development*

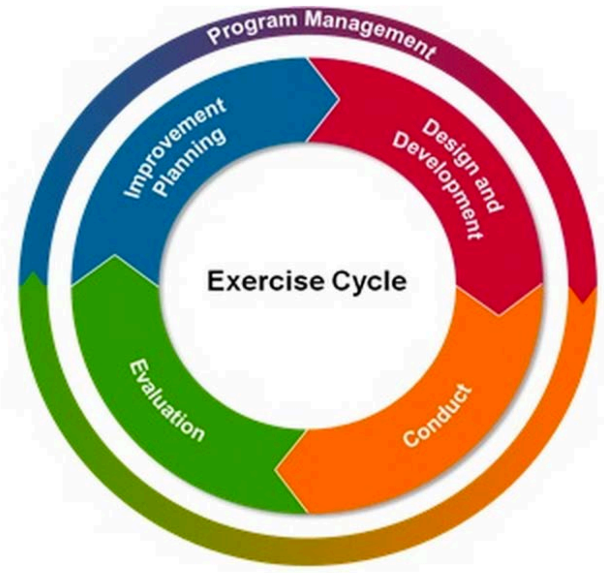
# Why Exercises?

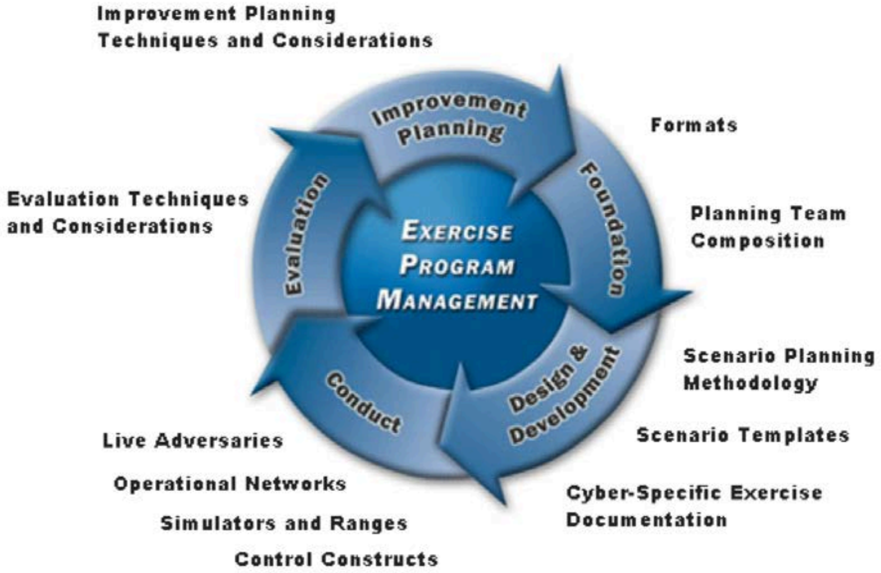
- Experience building
  - Safe environment
  - Repeatable
- Demonstrate capabilities
  - Integration of people, processes, and technology
- Experimentation
  - Tactics, techniques, and procedures
- Focus on process improvement
  - Organizational education

# Proven Approach

- Exercises have been used to prepare for natural disasters and physical hazards for many years
  - Military "wargaming" → early 1800's
- Homeland Security Exercise and Evaluation Program (2002)
  - Based on DOD training and exercise programs
  - Fundamental principles that frame a common approach to exercises
  - Unique challenges for cyber
- *National Strategy to Secure Cyberspace* (2003)
  - Cyber exercises identified as a critical component to develop public-private partnerships and evaluate cyber security continuity plans

# HSEEP


Program Management
Improvement Planning
Design and Development
Exercise Cycle
Evaluation
Conduct


Improvement Planning Techniques and Considerations
Improvement Planning
Formats
Evaluation Techniques and Considerations
Foundation
Planning Team Composition
Evaluation
Exercise Program Management
Scenario Planning Methodology
Conduct
Design & Development
Scenario Templates
Live Adversaries
Operational Networks
Cyber-Specific Exercise Documentation
Simulators and Ranges
Control Constructs

# Cyber Exercise Hurdles

- Requires operational realism to enhance value
- Lack of codified best practices leads to ad hoc formats and planning methodologies
- Unique complexities based on the technical nature of cyber exercises
- Rapidly evolving policies, actions, and doctrine

# Definitions

- **Exercise** – a military maneuver or simulated wartime operation involving planning, preparation, and execution that is carried out for the purpose of training and evaluation*
- **Exercise Objective** – a specific statement of purpose, guidance, and/or direction for an exercise*
- **Cyber** – people, process, technology, and operations associated with digital information systems, networks, and data**
- **Cyber Exercise** – an exercise whose objectives primarily focus on protecting, defending, and recovering cyber assets and operations from a cyber attack or incident**

* Source: CJCSM 3500.03D, 15 AUG 2012

** Source: Methods for Enhanced Cyber Exercises

# Exercises

- Influenced by organizational resources and exercise objectives
- **Discussion-based** focus on familiarization of plans, policies, agreements, and procedures
  - Tabletop Exercise (TTX)
  - Seminar
  - Workshop
  - Game
- **Operations-based** validate plans, policies, agreements, and procedures while clarifying roles and responsibilities
  - Drill
  - Functional Exercise
  - Full Scale Exercise

# Exercise Complexity

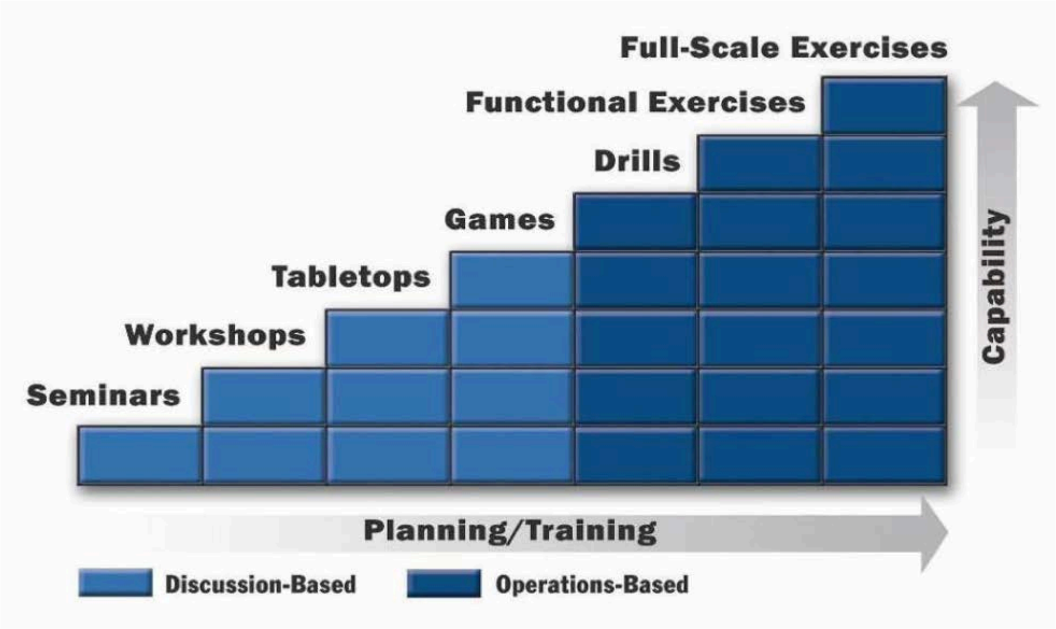


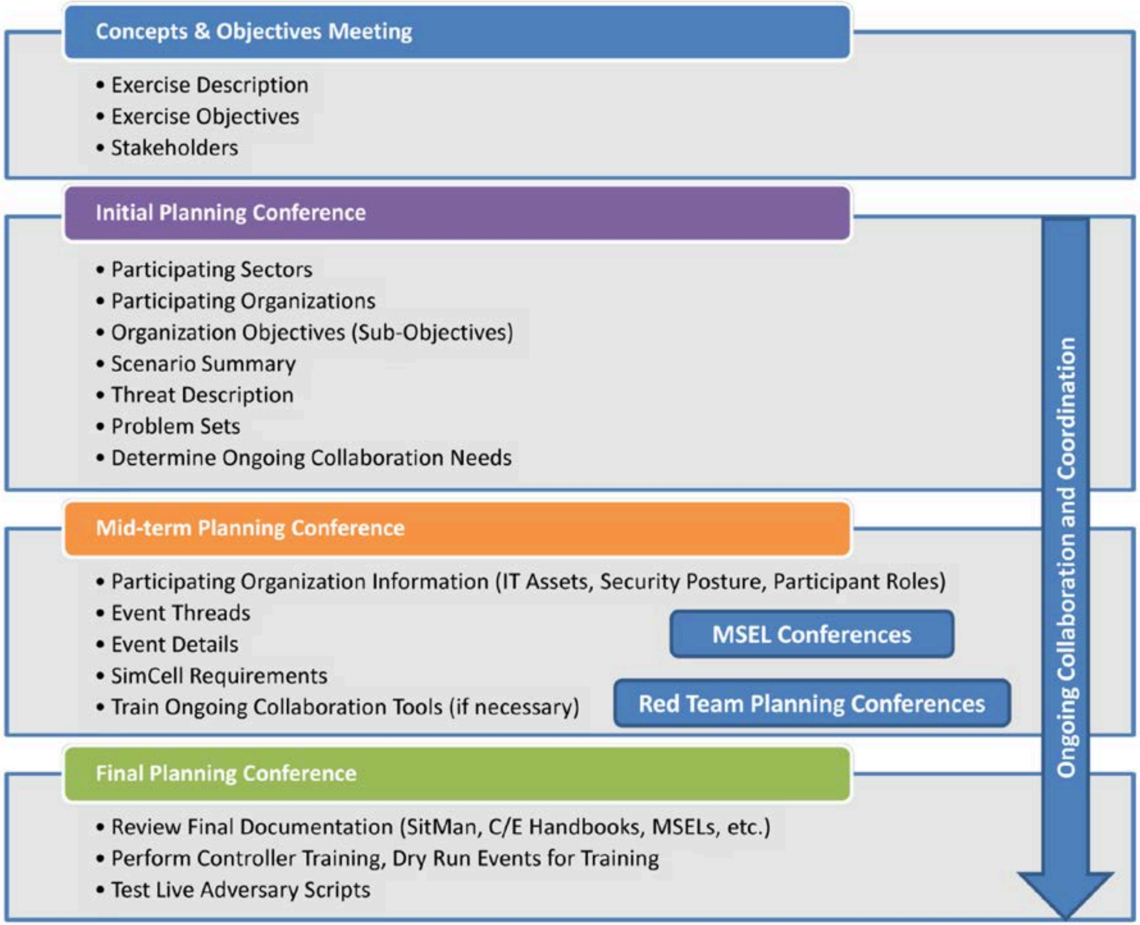
*Figure 3: HSEEP Building-Block Approach* [14]

Source: Methods for Enhanced Cyber Exercises

# Foundation: Exercise Planning

- Executive and leadership support and commitment
  - Objectives
  - Resources
- Establish an exercise planning team
- Develop a project management timeline and clearly identify milestones

# Building to the Event



**Concepts & Objectives Meeting**

- Exercise Description
- Exercise Objectives
- Stakeholders

**Initial Planning Conference**

- Participating Sectors
- Participating Organizations
- Organization Objectives (Sub-Objectives)
- Scenario Summary
- Threat Description
- Problem Sets
- Determine Ongoing Collaboration Needs

**Mid-term Planning Conference**

- Participating Organization Information (IT Assets, Security Posture, Participant Roles)
- Event Threads
- Event Details
- SimCell Requirements
- Train Ongoing Collaboration Tools (if necessary)

MSEL Conferences

Red Team Planning Conferences

**Final Planning Conference**

- Review Final Documentation (SitMan, C/E Handbooks, MSELs, etc.)
- Perform Controller Training, Dry Run Events for Training
- Test Live Adversary Scripts

Ongoing Collaboration and Coordination

Source: Methods for Enhanced Cyber Exercises

# Teams

- Planning teams are usually based on the type of exercise, complexity, scenario, location, and resources available
- Scalable 4-cell planning construct
  - Exercise Control (White Cell)
  - Threat Emulation (Red Cell)
  - Observer/Controllers/Evaluators (Black Cell)
  - Trusted Agents

# Design: Objectives

- Well-defined objectives guide scenario development and evaluation criteria

- Exercise objectives (SMART):
  - **S**imple
  - **M**easurable
  - **A**chievable
  - **R**ealistic
  - **T**ask-oriented

- Most importantly, objectives should be specific and relevant

  "Identify potentially compromised systems that are communicating with an adversary C2 node via DNS."

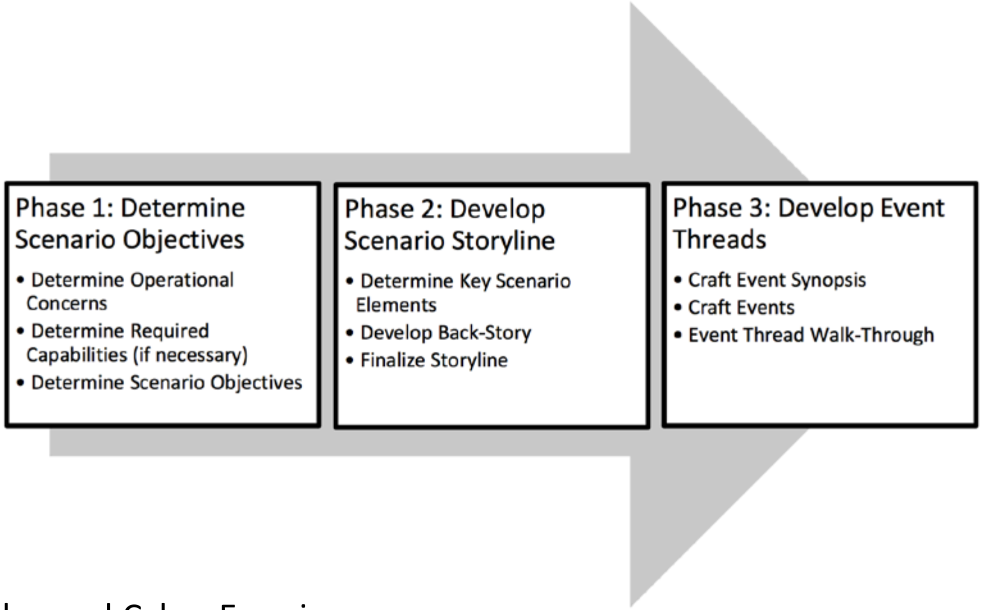
- Recommend limiting the number of objectives to ensure exercise is manageable

# Design: Scenario

- The storyline that drives the exercise
  - Integration of realistic threats with a plausible story
  - Every aspect of the scenario should support specific exercise objectives
- Key scenario elements
  - Scenario objective(s)
  - Threat
  - Target
  - Operational effect (not necessarily business impact)
- Collaborative effort → Trusted Agents (SMEs)
  - Threats
  - Cyber defense capabilities
  - Policies and procedures
  - Project and/or organizational considerations

# Scenario Planning Methodology

- Phase 1: Develop Scenario Objectives
- Phase 2: Develop Scenario Storyline
- Phase 3: Develop Event Threads



Phase 1: Determine Scenario Objectives

- Determine Operational Concerns
- Determine Required Capabilities (if necessary)
- Determine Scenario Objectives

Phase 2: Develop Scenario Storyline

- Determine Key Scenario Elements
- Develop Back-Story
- Finalize Storyline

Phase 3: Develop Event Threads

- Craft Event Synopsis
- Craft Events
- Event Thread Walk-Through

Source: Methods for Enhanced Cyber Exercises

# Key Scenario Elements

- Scenario objective(s)
  - Scenario objectives deconstruct exercise objectives into activities that can be developed as event threads
- Road to war – overview of the situation
- Threat
  - Actors and motivations
  - Live OPFOR
  - TTPs
- Target
  - Systems
  - Information/data
  - People
  - Processes
- Operational effect (not necessarily business impact)
  - Target effect
  - Discovery
  - Timeframe

# Development: Scenario

- Master Scenario Event List (MSEL)
  - Chronological list of observable events during the exercise period
- Exercise event-level (lowest level)
  - Scenarios can have multiple event threads
  - Event threads typically have multiple events
- Event types
  - Threats
  - Injects
  - Player expected action
  - White-noise

# Exercise Environment

- Exercise realism
  - Operational network v. cyber range
  - Scenario validation/plausibility
  - Systems and processes
  - Threat emulation
  - Traffic generation

# Exercise Execution

- Exercise Control – maintain positive control of all activities including MSEL execution, ensuring objectives are met, and conducting briefings
  - Staffing from across the planning team
  - STARTEX/PAUSEX/ENDEX
  - Exercise Rules of Engagement (EXROE)
- Communications
  - Primary and backup communication channels

# Documentation

- Scenario Mapping
- MSEL
- Playbooks
- Instructor/facilitation guides
- Range infrastructure
- Exercise environment configuration
- Data handling procedures
- … many, many more

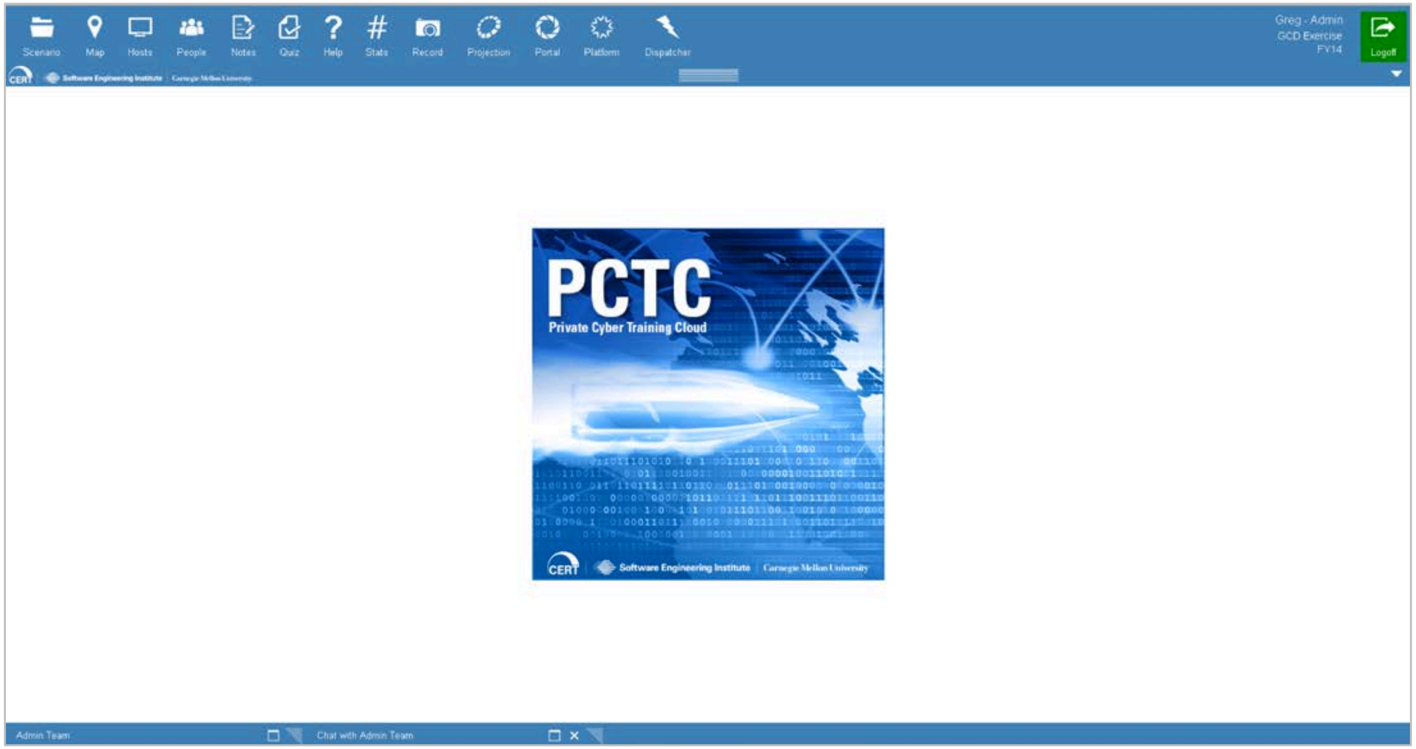
# Lessons Learned

- Effective process improvement completes the exercise cycle
- After Action Review
  - Drive organizational change
  - Improve the exercise experience

# Misc Cyber Exercises

- Notable cyber exercises
  - Cyber Storm (DHS NCSD)
  - Cyber Flag (USCYBERCOM)
  - Cyber Guard (USCYBERCOM, NGB, DHS, FBI)
  - Cyber Defense Exercise (DOD, Service Academies)
  - CyberPatriot (AFA)
  - Cyber Shield (NGB)
  - Bulwark Defender (USSTRATCOM)
  - …
- Cyber training and exercise service providers
  - Online competitions
  - Challenges

# Demo


Scenario
Map
Hosts
People
Notes
Quiz
Help
Stats
Record
Projection
Portal
Platform
Dispatcher
Greg - Admin
GCD Exercise
FY14
Logoff
CERT
Software Engineering Institute
Carnegie Mellon University
PCTC
Private Cyber Training Cloud
Admin Team
Chat with Admin Team

# Summary

- Cyber exercises enable experience building in a controlled environment
- Effective planning is critical to the success of the exercise
- HSEEP provides a framework for designing cyber exercises based on best practices and a proven methodology

# References

CHAIRMAN OF THE JOINT CHIEFS OF STAFF MANUAL

CERT® Approach to Cybersecurity Workforce Development
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Chairman of the Joint Chiefs of Staff Manual 3500.03D – Joint Training Manual for the Armed Forces of the United States
http://www.dtic.mil/doctrine/training/cjcsm3500_03d.pdf

DHS Exercise and Evaluation Program (HSEEP)
https://www.llis.dhs.gov/hseep

Methods for Enhanced Cyber Exercises
https://www.llis.dhs.gov/sites/default/files/Methods%20for%20Enhanced%20Cyber%20Exe
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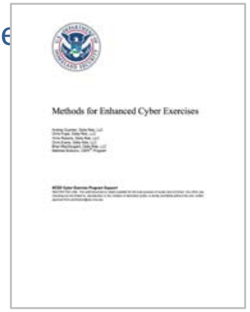
Methods for Enhanced Cyber Exercises

# Questions

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